

DRAFT NPRM

DATED September 14, 1998

This draft Notice is revised to include the comments from the July, 1998 ARAC meeting in Seattle.

[4910-13]

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

[14 CFR Part 25]

[Docket No. ; Notice No.]

RIN: 2120-

Engine Inflight Restart Requirements

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of proposed rulemaking.

SUMMARY: This notice proposes an amendment to the airworthiness standards for transport category airplanes to establish engine inflight restart requirements following the loss of all engine power. The need for a rule change is based upon review of service experience that shows cases of all engine thrust losses (flameouts or shutdowns) have occurred for various causes and the ability to restart engines was required to provide continued safe flight and landing. Review of FAA approved inflight restart envelopes for some newly certificated airplanes shows reduced engine windmill restart capability which has significantly increased altitude loss required to affect engine restart following all engine thrust loss. This information indicates there is a need to revise the inflight engine restart requirements to provide minimum engine relight capability within the airplane operating envelope following loss of all engine thrust. If adopted, this proposal would establish requirements for inflight engine restart capability following loss of all engine power for transport category airplanes.

These proposals were developed in cooperation with U.S. and European aviation industry task groups including the Aerospace Industries Association of America (AIA) and the European Association of Aerospace Industries (AECMA). These changes are intended to benefit the public interest by establishing a minimum standard for recovery following the flameout or shutdown of all engines.

DATE: Comments must be received on or before

ADDRESS: Comments on this proposal may be mailed in triplicate to: Federal Aviation Administration, Office of the Chief Counsel, Attention: Rules Docket (AGC-10), Docket No. 800 Independence Avenue SW., Washington, D.C. 20591, or delivered in triplicate to: Room 915G, 800 Independence Avenue SW., Washington, D.C. 20591. Comments delivered must be marked: Docket No. Comments may be inspected in Room 915G weekdays, except Federal holidays, between 8:30 a.m. and 5:00 p.m. In addition, the FAA is maintaining an information docket of comments in the Office of the Assistant Chief Counsel (ANM-7), FAA, Northwest Mountain Region, 1601 Lind Avenue S.W., Renton, Washington 98055-4056. Comments in the information docket may be inspected in the Office of the Assistant Chief Counsel weekdays, except Federal holidays, between 7:30 a.m. and 4:00 p.m.

FOR FURTHER INFORMATION CONTACT: Michael J. Kaszycki, Airframe and Propulsion Branch (ANM-112), Transport Airplane Directorate, Aircraft Certification Service, FAA, Northwest Mountain Region, 1601 Lind Avenue S.W., Renton, Washington 98055-4056; telephone (425) 227-2137.

SUPPLEMENTARY INFORMATION:

Comments Invited

Interested persons are invited to participate in this proposed rulemaking by submitting such written data, views, or arguments as they may desire. Comments relating to the environmental, energy, or economic impact that might result from adopting the proposals contained in this notice are invited. Substantive comments should be accompanied by cost estimates.

Commenters should identify the regulatory docket or notice number and submit comments, in triplicate, to the Rules Docket address specified above. All comments received on or before the closing date for comments will be considered by the Administrator before taking action on this proposed rulemaking. The proposals contained in this notice may be changed in light of comments received. All comments will be available in the Rules Docket, both before and after the closing date for comments, for examination by interested persons. A report summarizing each substantive public contact with FAA personnel concerning this rulemaking will be filed in the docket. Commenters wishing the FAA to acknowledge receipt of their comments must submit with those comments a self-addressed, stamped postcard on which the following statement is made: "Comments to Docket No. .” The postcard will be date/time stamped and returned to the commenter.

Availability of NPRM

Any person may obtain a copy of this Notice of Proposed Rulemaking (NPRM) by submitting a request to the Federal Aviation Administration, Office of Public Affairs, Attention: Public Inquiry Center, APA-430, 800 Independence Avenue SW., Washington, D.C. 20591, or by calling (202) 267-3484. Communications must identify the notice number of this NPRM. Persons interested in being placed on a mailing list for future rulemaking documents should also request a copy of Advisory Circular No. 11-2A, Notice of Proposed Rulemaking Distribution System, which describes the application procedures.

Discussion of the Proposals:

Following several all engine out incidents, the FAA held a public meeting in 1986 to discuss all engine out restart capabilities. Subsequently the FAA issued special conditions that established minimum restart requirements that were intended to maintain the level of safety on new type designs to that of earlier technology airplanes. The Joint Aviation Authorities (JAA) have already clearly defined the European engine restart requirements in ACJ of JAR-25. The JAA has published specific guidance regarding the minimum restart requirements within the Acceptable Means of Compliance and Interpretations-ACJ to the Joint Airworthiness

Requirements (JAR). The guidance includes; flight crew delay times for initiation of a start, guidelines for test altitudes, configurations, and airspeeds associated with starter assist and windmill restart of engines. Differences between the FAA special conditions and the JAA compliance criteria for showing compliance to 25.903(e) have resulted in two different standards for certification of transport airplanes. Thus, the objective of this proposed amendment is to establish a minimum standard for recovery following the flameout or shutdown of all engines.

Regulatory History

The inflight engine restart requirements for turbine powered airplanes are identified in §§ 25.903, 25.1351 and 25.1585 of the Federal Aviation Regulations (FAR). Sections 25.903 and 25.1585 requirements were developed from the engine inflight restart requirements of the earlier Civil Air Regulations (CAR) Part 4b. Paragraph 4b.401(c) required the ability for individually stopping and restarting the rotation of any engine during flight. This intention was further incorporated into Part 25, specifically § 25.903(e), which requires 1) the ability to restart any engine during flight must be provided, 2) an altitude and airspeed envelope must be established for inflight engine restarting, and each engine must have a restart capability within that envelope and, 3) if the minimum windmilling speed of the engines following the inflight shutdown of all engines, is insufficient to provide the necessary electrical power for engine ignition, a power source independent of the engine driven electrical power generating system must be provided to permit inflight engine ignition for restarting. In addition, FAR 25.1351(d) requires demonstration that the airplane can be operated for 5 minutes following the loss of all normal electrical power (excluding the battery) with the critical type fuel (from the standpoint of flame out and restart capability) and with the airplane initially at the maximum certificated altitude. For airplanes equipped with Alternating Current (AC) powered fuel pumps, this requirement has resulted in demonstration of the capability to windmill relight the engine while on suction feed with battery power for ignition with relight usually occurring at altitudes between 16,000 to 25,000 feet.

In addition, as stated earlier in CAR 4b.742(d), the recommended procedures to be followed in restarting turbine engines in flight are to be described, including the effects of altitude. This intention was also incorporated into Part 25, specifically § 25.1585(a), which states that information and instructions must be furnished, together with recommended procedures for restarting turbine engines during flight (including the effects of altitude).

Background

Since the introduction of turbojet and turbofan engines into commercial service newer technology high bypass ratio engines have been developed which improve fuel efficiency, reduce emissions, and improve engine tolerance to severe inclement weather conditions. However, some engines incorporating these improvements have shown a tendency to require increased airspeed to provide sufficient windmilling rotational energy to the engine core for restarting. When the existing Part 25 requirement was developed the engine windmill relight capability covered nearly the entire airplane airspeed and altitude operational envelope, including low altitude low speed conditions. Many newer technology engines that incorporate improved fuel efficiency, lower emissions, and improved tolerance to inclement weather conditions have demonstrated relight envelopes which in many cases are limited to higher airspeed conditions. In addition, other engine installations have been developed which utilize free turbine type engines that may require either an electrical or pneumatic power source for inflight restart.

These characteristics have resulted in a gradual reduction in the size of engine inflight windmill relight envelopes on some newer technology engines. Today many newer technology airplanes require starter "assists" from a pneumatic source such as another operable engine or an inflight operable Auxiliary Power Unit (APU) over a large portion of the airplane operating envelope.

The task group, consisting of AIA, AECMA, and FAA members, has assembled a list of over thirty all engine out events that have occurred between 1959 and 1997. Review of reported incidents of all-engine flameout or shutdown events on transport category airplanes indicates that a minimum engine restart capability is needed to sustain the current level of safety. The

task group has recommended establishing a minimum engine restart capability for the all engine out case.

The data indicates that multi-engine flameouts or shutdowns have generally resulted from a common cause, such as fuel system mismanagement, crew action that inadvertently shutoff the fuel supply to the engines, exposure to common environmental conditions, or engine deterioration occurring on all engines of the same type.

Discussion

The current regulations were developed based on the understanding that turbine engines inherently had an adequate inflight windmill relight capability therefore, only an electrical power source for engine ignition was required to permit inflight engine restarting following an all engine flameout or shutdown. The reduction in restart capability that has occurred as new technology engines were developed was not foreseen when the restart regulations were promulgated. Several recently certified airplane types have a significantly reduced inflight windmill restart envelope, and assured recovery from an all-engine flameout or shutdown requires one of the following: (1) quick response from the flightcrew to restart the engines before the engine rotor speed falls below minimum values, (2) sufficient altitude to allow the flight crew time to achieve a high airspeed within the engine windmill restart envelope, or (3) an appropriate bleed air source such as an inflight operable APU to allow starter assisted engine restart.

The current regulations do not adequately assure successful inflight engine relight capability under certain circumstances, particularly during flight at low airspeeds and altitudes, following a multi-engine inflight flameout or shutdown. The FAA has concluded that a minimum level of restart capability is necessary to maintain an adequate level of safety for transport category airplanes.

The FAA has issued Airworthiness Directives requiring relocation of engine shutoff switches in one airplane type, increased inflight engine idle thrust levels during descent and subsequent engine modifications to another airplane type to reduce the likelihood of all engine

out incidents occurring as described earlier. In addition, aircraft manufacturers have developed new flight crew procedures to achieve "rapid" relight of the engines following failure so that relight can be attained before the engine rotor speed falls below minimum values during the takeoff portion of the flight. The FAA is continually monitoring service difficulty reports to determine if AD action may be necessary on other transport airplanes that may exhibit unsatisfactory engine relight capability. Newer technology higher bypass ratio engines currently under development are expected to have inflight restart envelopes that require starter assisted relight capability over a larger portion of the present baseline envelope. The FAA proposes to revise the regulatory standard to provide an adequate level of safety.

Regulatory Options

Within the regulatory revision context, several options were considered by the FAA, including: (1) requiring a windmill start capability throughout an airplane's entire flight envelope thus alleviating the all-engine flameout/relight concern, (2) requiring additional equipment necessary to provide expanded starter assistance capability, such as start cartridges, (3) requiring certification of an inflight operable APU as an acceptable air source for starter assistance and thereby making APU's required airplane equipment and requiring either full time operation during certain portions of flight or demonstrated ability to start the APU when needed.

The proposed amendment does not specifically require or prevent any or all of the options presented above. The airplane manufacturer may investigate these options and any others for a suitable method to provide the required engine inflight restart capability.

Regulatory Intent

The FAA considers that a reasonable restart envelope must assure restart of the engines prior to a loss in altitude that would preclude continued safe flight and landing.

Several methods are available to an applicant that would permit a more responsive and reliable restart capability, such as providing an inflight operable APU within the restart envelope for engine starter assistance or providing engine modifications. Other methods may also be available to the applicant to ensure a reliable restart capability. Therefore the FAA does not require, within the proposed regulatory amendment, any specific method that would satisfy the minimum inflight restart requirement.

Future Advisory Circular

Many variables presently exist that influence the capability of turbojet engines to perform an acceptable inflight restart, including: engine bypass ratio, altitude and airspeed/mach number, engine stability, outside air temperature, the presence of precipitation, idle rotor speed, shut-down duration (cold soak), engine time since overhaul, installed configuration (accessory loads); and engine fuel control/surge bleed valve schedules. These and other variables may equally affect the capability of a turbopropeller engine to restart during flight.

Although it is necessary for all engine installations to be flight tested to establish and demonstrate an engine restart envelope during flight, the FAA has not required each engine type to demonstrate restart capability under the influence of all variables affecting restart capability. Some technical experience and analysis may be necessary to determine those variables with the greatest effect on the engine restart capability and those that would reasonably need to be considered to assure continued safe flight and landing.

The group has also assisted the FAA in developing an advisory circular to identify and clarify acceptable means to demonstrate compliance with the regulation proposed within this notice. This AC will provide guidelines to be used by the airframe manufacturer for conducting a safety analysis to establish both the minimum required restart capability and assist in certification flight test planning.

Regulatory Evaluation

Regulatory Flexibility Determination

Under the criteria of the Regulatory Flexibility Act of 1980 (RFA), the FAA has determined that the proposed rule would not have a substantial economic impact on a substantial number of small entities.

Since the act applies to U.S. entities, only U.S. manufacturers of transport category airplanes would be affected. In the United States, the Boeing Company is the only manufacturer that specializes in commercial transport category airplanes. In addition, there are a number of others that specialize in the manufacture of other transport category airplanes, such as those designed for executive transportation. These include Cessna Aircraft Corporation, Bombardier, Raytheon, and Gulfstream American Corporation.

The FAA size threshold for a determination of a small entity for U.S. airplane manufacturers is 75 employees; any U.S. airplane manufacturer with more than 75 employees is considered not to be a small entity. Because none of the transport category airplane manufacturers is a small entity, there would be no impact on any small entity as the result of the implementation of this proposal.

International Trade Impact Assessment.

The proposed rule is not expected to have an adverse impact either on the trade opportunities of U.S. manufacturers of transport category airplanes doing business abroad or on foreign airplane manufacturers doing business in the United States. Since the certification rules are applicable to both foreign and domestic manufacturers selling airplanes in the United States, there would be no competitive trade advantage to either.

Federalism Implications

The regulation proposed herein would not have substantial direct effects on the states, on the relationship between the national government and the states, or on the distribution of power and responsibilities among the various levels of government. Therefore, in accordance with Executive Order 12612, it is determined that this proposal would not have sufficient implications to warrant the preparation of a Federalism Assessment.

CONCLUSION: Because the proposed provisions are not expected to result in a substantial economic cost; the FAA has determined that this proposed regulation is not considered to be major under Executive Order 12291. Additionally, as this document involves an issue that has not prompted a great deal of public concern, it is not considered significant under Department of Transportation Regulatory Policies and Procedures (44 FR 11034; February 26, 1979). Since there are no small entities affected by this rulemaking, it is certified under the criteria of the Regulatory Flexibility Act that this proposed rule, if promulgated, would not have a significant economic impact, positive or negative, on a substantial number of small entities. A copy of the initial regulatory evaluation prepared for this project may be examined in the public docket or obtained from the person identified under the caption, "FOR FURTHER INFORMATION CONTACT."

List of Subjects in 14 CFR Part 25: Aircraft Aviation safety, Engines, Restart.

The Proposed Amendment

Accordingly, the Federal Aviation Administration (FAA) proposes to amend Part 25 of the Federal Aviation Regulations (FAR), 14 CFR Part 25, as follows:

Part 25 - AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY
AIRPLANES

1. The authority citation for Part 25 continues to read as follows:

Authority: 49 U.S.C. 1344, 1354(a)7 1355, 14217 1423,1424,1425,1428,
1429, 1430; 49 U.S.C. 106(g) (Revised Pub. L. 97-449; January 12, 1983);
and 49 CFR 1.47(a).

2. By amending § 25.903 by adding a new paragraph (e)(4) that read as follows:
§ 25.903 Engines.

* * *

EXISTING WORDING SHOWN FOR COMPLETENESS

(e) Restart Capability.

- (1) Means to restart any engine in flight must be provided.
- (2) An altitude and airspeed envelope must be established for in-flight engine restarting, and each engine must have a restart capability within that envelope.
- (3) For turbine engine powered airplanes, if the minimum windmilling speed of the engines, following the in-flight shutdown of all engines, is insufficient to provide the necessary electrical power source independent of the engine-driven electrical power generating system must be provided to permit in-flight engine ignition for restarting.

(PROPOSED AMENDMENT TO TEXT)